

PAROPISTHORCHIS CANINUS

THE LIVER-FLUKE OF THE INDIAN PARIAH DOG

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Among a collection of specimens presented in 1911 to the Museum of the Liverpool School of Tropical Medicine by Captain R. Markham Carter, I.M.S., there was a bottle containing two small flukes. They were got from the liver of a native dog at Kasauli, India. On examining them I found that they were spinose flukes resembling those originally described by J. F. P. McConnell (1876 and 1878), from two Mahommedans, post mortem, and by T. R. Lewis and D. Cunningham (1872), and T. R. Lewis (1888), from the liver of the pariah dog. Lewis had thought that the flukes in question were *Distomum conjunctum*, Cobbold, but, as the figures show, they were certainly not this species, and Braun (1903) re-named them *Opisthorchis noverca*.

As this fluke, then, had not been described or recorded from India since 1878, I determined to re-examine it. A preliminary examination of Captain Carter's specimens left me in considerable doubt as to the nature of certain appearances. I accordingly wrote to Major Christophers, I.M.S., at Kasauli, who very kindly sent me a fresh supply, and stated that he could procure as many as I wanted. I mention this as it is evidence of the extreme commonness of this fluke in the North-West provinces at least, as, indeed, has quite recently been shown by the data of Gaiger (1911), who records nineteen out of fifty dogs infected.

External appearance. The most striking feature of this fluke when examined with a pocket lens is a cylindrical process, about $1\frac{1}{2}$ mm. long, projecting from the anterior portion of the ventral surface, which on closer inspection is seen to bear on its summit the ventral sucker and opening of the common genital pore. In my original specimens this stalk, or pedicle, was not visible, as it was retracted, and I was at first much puzzled by the spherical structure surrounding the sucker.

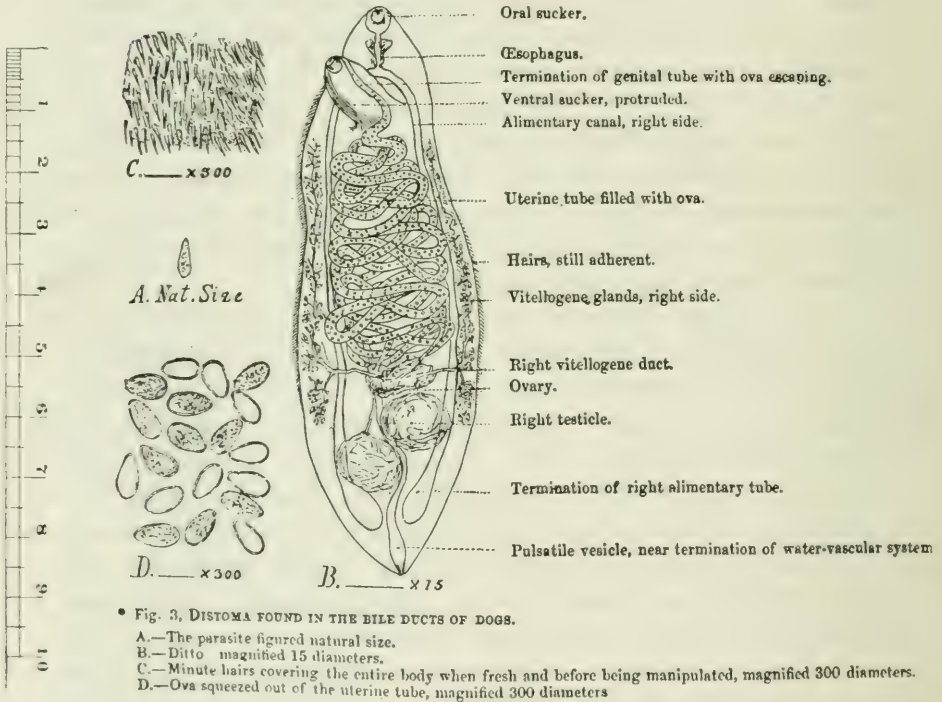
The length of the fluke is:—

Sublimate specimens (6) ...	average	3.6 m.m.,	maximum	5.5,	minimum	2.75
Formalin 10 % specimens (6) ...	"	5.2	"	5.75,	"	4.75
Alcohol 70 % specimens (6) ...	"	3.96	"	4.6,	"	3.5

The body is uniformly spinose, though, as a rule, spines are not present on the pedicle. In preserved specimens the body is slightly concavo-convex, the concavity being ventral.

Alimentary canal. The mouth is directed ventrally. The diameter of the oral sucker is 0.28 mm. The pharynx measures 0.224 by 0.184 mm., and is followed by a narrow oesophagus 0.04 mm. long.

The ventral sucker is 0.176 mm. in diameter.



Vitellaria. Consist of eight acini on each side, extending from slightly behind the base of the pedicle to the anterior border of the ovary or as far back as a line separating the posterior border of the ovary from the anterior border of the anterior testis. The arrangement of the acini is very constant, and in the examples I have examined I have found no appreciable variation. Inwardly

NOTE.—The figure on this page is a reproduction of Lewis and Cunningham's original figure (vide literature p. 123).

they encroach but little, if at all, on the gut caeca. The transverse vitelline ducts pass inwards and backwards from the level of the seventh acinus. They unite in rather an open **V** to form a receptacle dorsal to the anterior lobe of the ovary, at or slightly behind the level of the posterior vitelline acini. The junction of the radicles which go to form the transverse ducts on either side has the following arrangement. The duct from acini 1-6 is joined by that from acinus 7 and at the same point by the duct from acinus 8, but this arrangement, while commonest, is subject to some variation.

Testes. The anterior testis is 0.496 by 0.440 mm. The posterior testis is 0.520 by 0.480 mm. They are, as a rule, ovoid though they may also be to some extent regularly lobate, e.g., in one specimen examined the posterior testis was trilobed. One lies obliquely behind and adjacent to the other. The anterior testis is usually on the left side and the posterior testis on the right side. In some cases the organs are reversed, i.e., the anterior testis is on the right side and the posterior on the left side, with the seminal receptacle on the left side and commencing uterine duct on the right side.

The gut is slightly displaced by the anterior and more so by the posterior testis.

The left vas efferens passes forward parallel to the edge of the gut caecum. The right vas efferens runs a wavy course parallel to the right caecum, disappearing dorsally to the seminal vesicle.

The ovary is multilobular, the lobes (6-8) being irregular in size and shape. Not uncommonly the ovary shows three ovoid lobes ventrally.

Excretory vesicle. Curving forward between the testes, expands into a pyriform sac behind the ovary. The transverse excretory ducts enter this sac laterally forming a **Y**.

The right duct curves around the end of the seminal receptacle and crosses ventral and obliquely to the gut caecum; the left passes around the anterior border of the anterior testis. Anteriorly the longitudinal ducts can be traced as far forward as the bifurcation of the gut.

Shell gland. Extensive and diffuse, occupies an area between the ovary, seminal receptacle and the first uterine coil, and extending laterally beyond the left transverse vitelline duct. The area corresponds approximately to the loop of the vitelline glands.

Seminal receptacle. Banana-shaped, globular or pyriform, is situated to right of and dorsal to posterior lobe of ovary, may extend as a twisted sac as far as the gut caecum. It is distended with spermatozoa.

Laurer's canal. Arising from an ampulla at the end of the seminal receptacle, runs with a single curve medially and backwards, opening lateral to the anterior testis. In other cases after running backwards it bends forwards again and opens about the level of its point of origin. The opening is surrounded by an area, free from spines, in diameter about three times that of the opening.

Uterine coils. Commence at the level of the hindmost vitelline acini. They form rather loosely packed transverse loops, terminating slightly in front of the level of the first vitelline acini. From here the uterus passes forwards into the pedicle to the left and ventral to the seminal vesicle. The folds slightly overlap the caeca at some points, or displace them outwardly at others.

Seminal vesicle. Commences about the level of the first vitelline acini. The coils rapidly develop in extent, extending ventrally and displacing the uterine coil ventrally and to the left, they now form in cross-section 5-6 coils occupying practically the whole thickness of the fluke. As the vesicle passes forward to the base of the pedicle it is embraced on either side by the muscular (longitudinal) fibres which constitute the main bulk of the pedicle (until the sucker is reached) and serve to retract it as a whole. Further forward it diminishes in extent and now lies in its dorsal (anterior) side extending forward between the base of the sucker and the dorsal wall (fig. 2).

Common genital sinus. The pedicle now consists of sucker surrounded by muscles in which lie the two genital ducts on the dorsal side. Projecting beyond the sucker is a cuticular rim, or rather two rims, in a groove between which are a number of scales densely crowded together (fig. 2). It is into this groove that the genital ducts open. The opening of the genital sinus, as seen in transverse section, appears as a crescentic space which is densely crowded with a number of finger-like scales (fig. 7). The cavity of the sinus now becomes continuous with the general cavity embraced by the cuticular rims (fig. 8). At this point the cuticular rim is usually entirely covered with scales, so that when the two cavities

become one, scales line the whole single lumen. While scales are present at the opening of the sinus, the extent to which they embrace the whole of the circumference is a variable one, as in some cases they can only be detected around the sinus itself. The opening is thus strictly speaking into the sucker cavity, though not into the muscular portion. The exact position, however, varies according to the state of contraction of the pedicle and the resulting alteration in the relationship of the parts. If the pedicle and sucker are in a state of relaxation, the cuticular rim projects over the lumen and the sinus opens inwardly. If, on the contrary, the pedicle and sucker are contracted, the latter is dilated and projects or is on a level with the retracted rim; the sinus then appears to open externally, in any case it is anterior to the sucker corresponding thus to the position in the *Opisthorchinae*. The varying position of the circlet of scales in the cuticular rim can be well seen in total specimens where the pedicle is somewhat contracted so that the apex of the pedicle can be viewed end on. It is then seen that the circlet of scales in some cases clusters around the opening of the sucker, whereas in other cases, due presumably to the contraction of the fibrils seen in figs. 7 and 8, the circlet of scales, now less closely clustered, is not at the apex of the pedicle, but lower down on its external surface.

To consider now the identity of this fluke.

Lewis and Cunningham (1872), and Lewis, T. R. (1888), figure two flukes, one natural size, the other $\times 15$, from the liver of an Indian dog. I have measured these and found the dimensions to be:—(1) 6.5×2.0 mm.; and (2) 6.3×2.0 mm., respectively.

McConnell, J. F. P. (1876), figures five flukes, four natural size and one $\times 6$, about, from the liver of man. These have the following measurements:—(1) 8.25×2.75 mm.; (2) 9.25×2.75 ; (3) 9.25×3.0 ; (4) 8.25×3.0 ; (5) 9.8×3.1 . Mean 8.96×2.9 mm.

He himself gives the following dimensions. Average length $3/8$ in. ($= 9.4$ mm.), average breadth $1/10$ in. ($= 2.5$ mm.). He also states that only one or two specimens were found $1/4$ in. ($= 6.25$ mm.), and that these showed evidences of immaturity. Again a few were also found $1/2$ in. ($= 12.5$ mm.) in length (but the great majority exactly $3/8$ in. ($= 9.4$ mm.)). In a second paper (1878) he makes the following statement: 'somewhat larger than the original entozoan discovered by Cobbold being fully $1/8$ in.

(9.4 mm.) in length, and several $1\frac{1}{2}$ in. (12.5 mm.) as against $1\frac{1}{4}$ in. (6.25 mm.) the average size of the latter.

Summing up these data we have:—

From McConnell's figures, average 8.96×2.9 mm., min. 8.25×2.75 , max. 9.8×3.1 mm.

„ „ data, „ 9.4×2.5 „ „ 6.25 „ „ 12.5 mm.

Thus the length varies from 6.2-12.5 mm. Compared with Lewis's and Cunningham's fluke, McConnell's appears to be longer, though we have no evidence as to whether the respective measurements were made all in the fresh, or whether some were fresh, other fixed.

Again McConnell does not make any mention of or figure the pedicle bearing the sucker and genital opening as it is correctly figured by Lewis, but, on the contrary, states that the 'reproductive papilla or genital orifice (is) placed a little above and to one side of the former' (ventral sucker) and figures it in this position. These facts, more especially the latter, would lead us to suspect the existence of two different flukes.

Again, I have measured the eight eggs figured by McConnell with the following results:—Length 29.1μ , 29.1μ , 29.1μ , 28.3μ , 28.3μ , 26.0μ , 26.0μ , 26.0μ . Average, 27.7μ .

Comparing these data we get:—

				Size of Eggs
Lewis	... figures	...		$20.8-26.6 \mu$, mode 22.5μ
McConnell	... „	...		27.7μ
McConnell	... measurements	...		$33.0 \mu \times 18.7 \mu$
Author	... „	...		range $28-30 \mu \times 12-14 \mu$, mode $28 \times 12 \mu$

These figures, then, do not throw much light on the question. It should be noted, however, that according to McConnell's *statement* the egg of his fluke is longer than that of the fluke measured by myself. On the contrary, Lewis only *figures* eggs, and makes no statement as to size; it is quite possible, therefore, that the discrepancy is not a real one, but dependent on errors of reproduction.

I think, however, for the reasons previously stated, there can be little doubt that the fluke I have described, and that from the dog described by Lewis, are identical.

If this be so, the question of the name of this fluke comes up for consideration. Braun, as we have seen, assumed, that these two

flukes were identical. I believe the evidence I have brought forward is sufficient to negative this view and that we are dealing with two distinct species. As regards the name *noverca*, used by Braun, in 1903, on the assumption that the two species were identical, it may, I think, be retained for McConnell's fluke, as Braun uses the latter's figure to illustrate his description, but as I consider that the fluke I am describing is the same as Lewis's or at least not the same as McConnell's, I propose for it the name *indicus*.* Further, as regards the generic position of this fluke, I hold that the anatomical difference, viz.: the existence of a process or pedicle bearing on its summit the genital opening and ventral sucker is sufficient to separate this fluke from the genus *Opisthorchis*. I propose to place it in a new genus, *Paropisthorchis*.

My proposed name for this fluke of the *Indian dog* will, therefore, be *Paropisthorchis indicus*.*

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* Barker 1911 (?) also concludes that these two flukes are different. He names McConnell's fluke *Amphimerus noverca*, and for Lewis's and Cunningham's suggests the specific name *caninus*. I accordingly withdraw the name *indicus*, and my suggested name for this fluke will therefore be *Paropisthorchis caninus*. I have to thank Dr. Leiper for a copy of Professor Barker's paper.

EXPLANATION OF PLATES

PLATE X

Fig. 1. Total specimen, stained, cleared in creosote, from ventral side. $\times 40$.

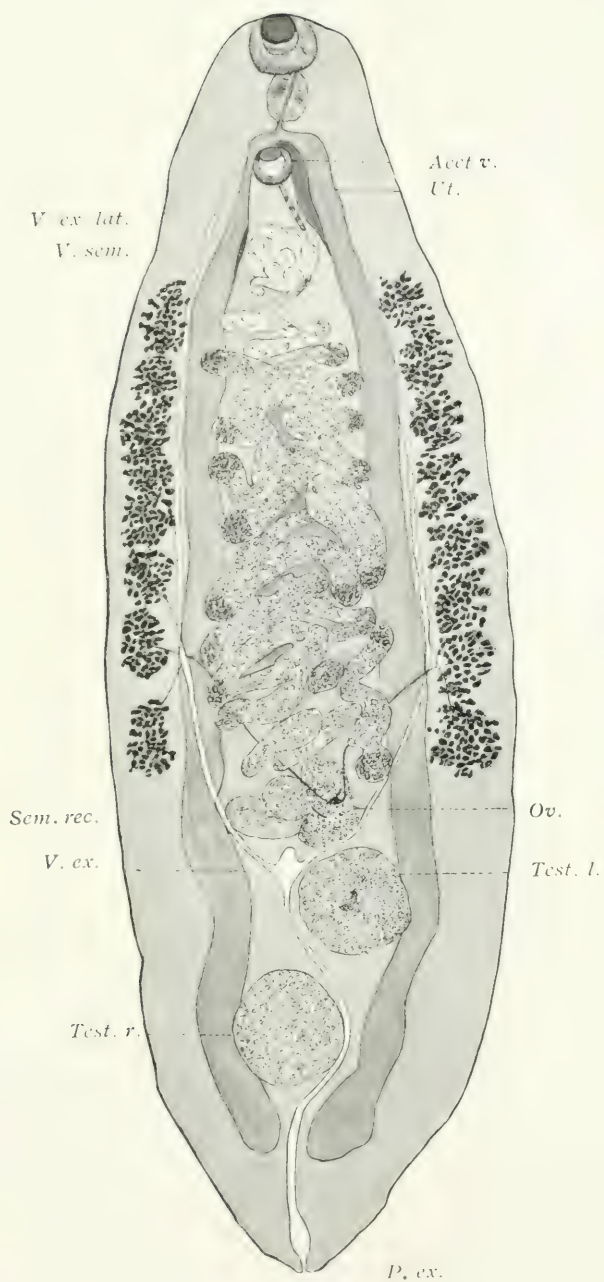


FIG. 1.

PLATE XI

- Fig. 2. Sagittal section; *b*, opening of seminal vesicle filled with scales. $\times 540$.
- Fig. 3. Frontal (somewhat oblique) section; *a*, ventral sucker; *b*, genital sinus. $\times 450$.
- Fig. 4. Frontal section, posterior to fig. 2, showing scales on right and left of the cuticular rim. $\times 450$.
- Fig. 5. Frontal section, posterior to fig. 4, showing scales on posterior border of opening. $\times 450$.

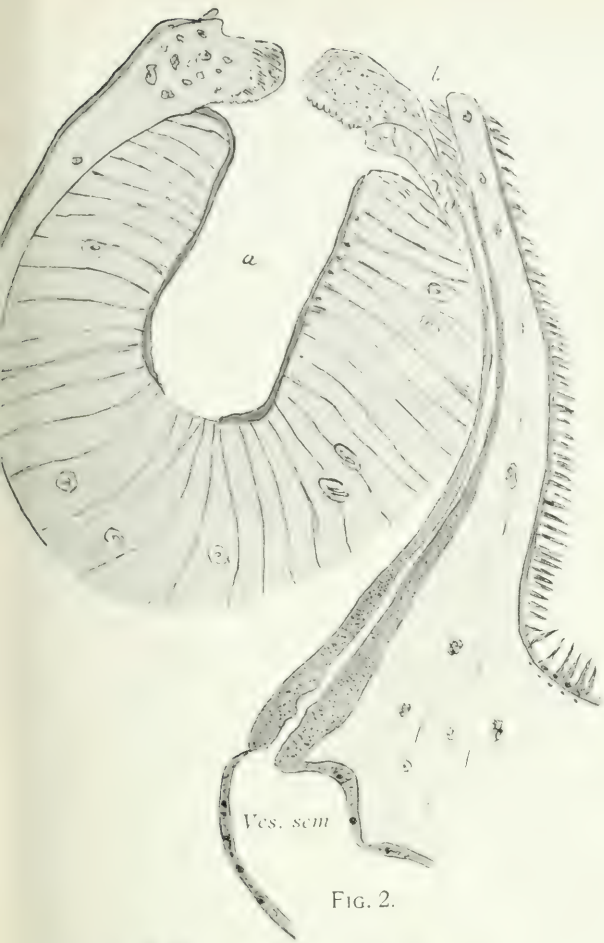


FIG. 2.



FIG. 5.

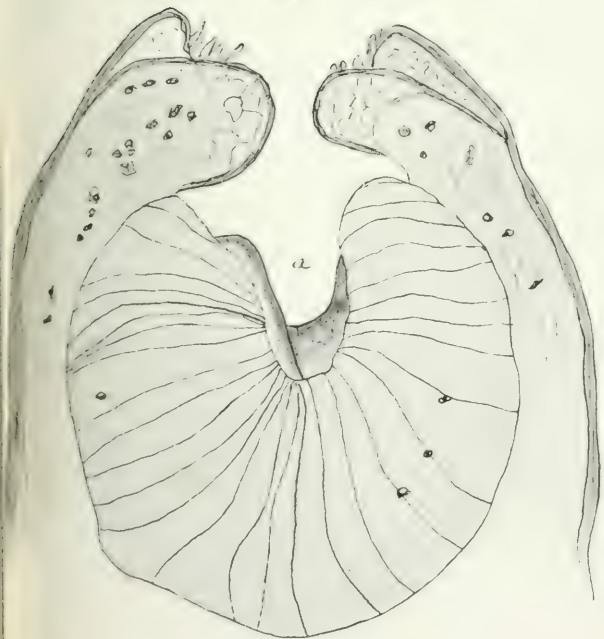


FIG. 4.

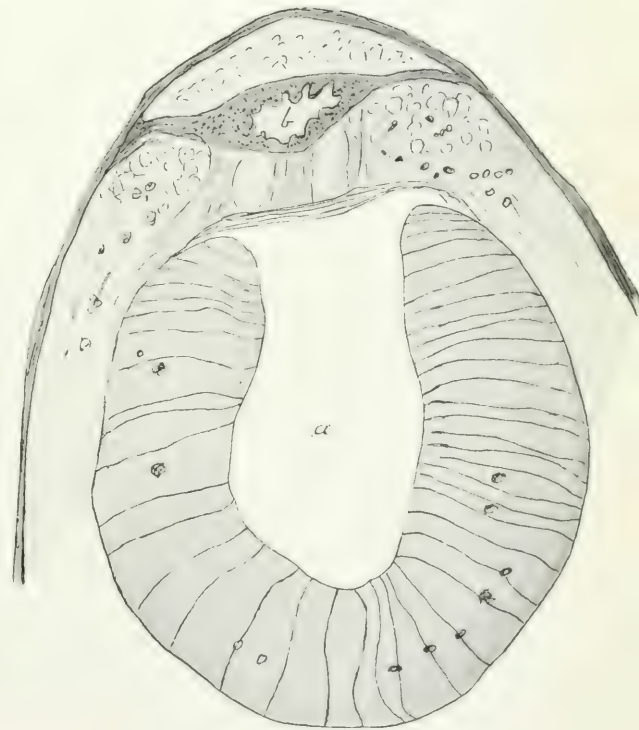


FIG. 3.

PLATE XII

- Fig. 6. Transverse section through pedicle; *a*, sucker, the lower portion is cuticular; *b*, genital sinus. $\times 450$.
- Fig. 7. Transverse section through pedicle, nearer the apex than fig. 6; *a*, sucker, or margin thereof, now entirely cuticular; *b*, genital sinus crowded with scales, *c*, radial fibrils which first appear at this level. $\times 450$.
- Fig. 8. Transverse section through pedicle, nearer the apex than fig. 7. The tubes *a* and *b* have now become confluent, and the whole cavity is surrounded by scales. $\times 450$.

12c

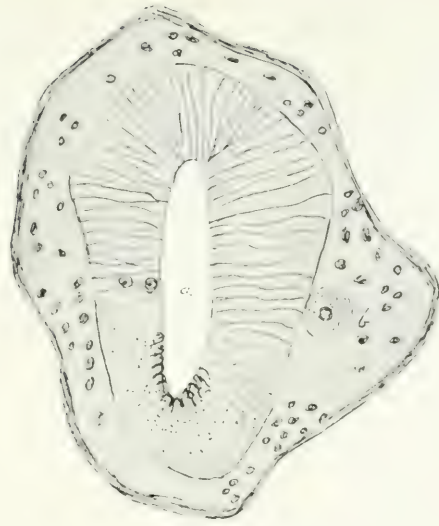


FIG. 6.

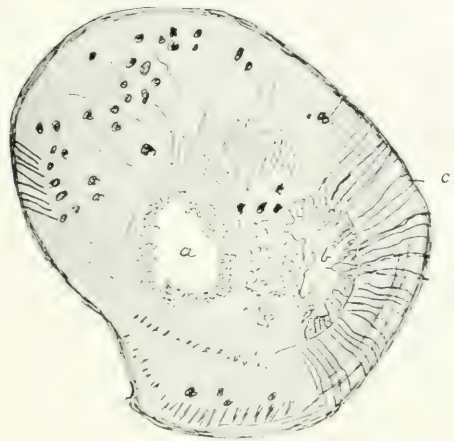


FIG. 7.



FIG. 8.